

“superne” should read “inferne” in the explanation of it. This is at once evident from the fact that there are no ambulacral grooves visible upon the skeleton of the arms, such as are shown in the representations of the same species (*Crotalocrinus pulcher*) on tab. viii. figs. 6 and 7. The calyx is broken across near the level of the tops of the basals, so that the internal faces of the radials and the following plates are exposed to view, with the remarkable striations upon them which were regarded by Angelin as corresponding to the consolidating apparatus of *Cupressocrinus*. It is possible that, like this structure, they may represent an uneven surface for the attachment of muscles and ligaments; but whatever else they may be, the striæ are certainly not hydrospireslits, as supposed by Wachsmuth and Springer in 1879. They appear to have still held this view even as late as last year, when they published the first section of the third part of the ‘Revision,’ for we find a reference to the presence of hydrospires in *Crotalocrinus* on p. 64, and on p. 83 this is extended into the following generalization:—“The Crotalocrinidæ have no ambulacral pieces, but possess hydrospires within the calyx.”

There is no mention of these hydrospires, however, in the subsequent definitions either of *Crotalocrinus* or of *Enalocrinus* in the second section of this part which has just appeared; and it is possible therefore that the authors have already given up their belief in the presence of these organs in the Crotalocrinidæ. But in any case they will no longer be able to refer to this family as Palæocrinoids which “probably have hydrospires within the calyx”*, and to use this supposed fact as an illustration of their theory that Blastoids, Cystids, and Crinoids are so closely linked together that they are not entitled to rank as Classes of Echinoderms equivalent to the Urchins and Starfishes. This point, however, is fully discussed elsewhere †.

BIBLIOGRAPHICAL NOTICES.

Revision of the Palæocrinoidea.—Part III. *Discussion of the Classification and Relations of the Brachiote Crinoids, and Conclusion of the Generic Descriptions.* By CHARLES WACHSMUTH and FRANK SPRINGER. Second Section. Extracted from the ‘Proceedings of the Academy of Natural Sciences,’ March 30, 1886. Philadelphia, 1886. Pp. 195.

WE are very glad to welcome the second and concluding section of the Revision of the Palæocrinoidea, Part III., by Messrs. Wachs-

* ‘Revision,’ part iii. p. 76.

† ‘Catalogue of the Blastoidea in the Geological Department of the British Museum (Natural History)’ (London, 1886), pp. 113-121.

muth and Springer, the first section of which was reviewed in the March number of this magazine.

The whole work is one of the utmost value to all palæontologists, and will be a lasting monument of patient and persevering industry on the part of the authors during a period of some eight or nine years. They now recognize 156 genera of Palæocrinoids, which include 1276 species; but they express their belief, which most palæontologists will share, that there are still many synonyms to be worked out. On the other hand, they describe themselves as possessing not less than 100 new species, and we are very glad to hear that these "will be described and amply illustrated hereafter in a Monograph on the Palæocrinoidæ of North America." We trust that the appearance of this monograph will not be too long delayed, and that it will contain tables or keys which will display the authors' views as to the mutual relations of the various families and genera of Palæocrinoids, including also the forty-nine non-American genera. Tables of this kind are of more use to the average worker than the most elaborate descriptions, and they have the additional advantage of informing the specialist as to the particular structural differences on which the authors rely as characters of systematic value.

This concluding section of the 'Revision' commences with an account of the suborder "Articulata," which comprises the two families Ichthyocrinidæ and Crotalocrinidæ, together with the problematical genus *Cleioocrinus*, Billings. We suspect, however, for reasons given on a previous page*, that whatever be the fate of *Cleioocrinus*, the Crotalocrinidæ will eventually have to be removed from their present association with the Ichthyocrinidæ, though we should not like to say where their ultimate resting-place will be.

The suborder "Inadunata" falls into the two branches, Larviformia and Fistulata. The former contains the four families Haplocrinidæ, Symbathocrinidæ, Cupressocrinidæ, and Gasterocomidæ; and the authors say of the whole group that they "probably possessed hydrospires and hydrospire pores, to connect with the ambulacra" (p. 157). This may perhaps have been the case in *Cupressocrinus*, but we cannot help thinking this statement to be a very rash one as regards the embryonic forms *Allageocrinus* and *Haplocrinus*. When the former genus was established in 1881 † it was made the type of a separate family, distinguished from the Haplocrinidæ by "the inequality in the size of the radials, owing to some of them being axillary," and the family Allageocrinidæ has since been accepted by De Loriol. So far as we are aware there is no other Crinoid known in which the first radials may be axillary; but Wachsmuth and Springer seem to consider this point so unimportant that they make no reference to it whatever outside their generic diagnosis of *Allageocrinus*. They describe the ventral pyramid above the mouth of this type as consisting of anchylosed

* *Antea*, pp. 397-406.

† *Ann. & Mag. Nat. Hist.* 1881, ser. 5, vol. vii. p. 292.

calyx-interradials and not of orals, a point upon which we differ from them altogether, as already explained*.

Passing on to the branch "Fistulata," we find that it includes the families Hyboocrinidæ, Heterocrinidæ, Anomalocrinidæ, Cyathocrinidæ, Poteriocrinidæ, Belemnoocrinidæ, Astyloocrinidæ, together with the Encrinidæ, Catilloocrinidæ, and Calceocrinidæ. The first of these comprises the three genera *Beroocrinus*, *Hoplocrinus*, and *Hyboocrinus*, together with the problematical *Hybocystites*, first described by Wetherby as a Cystid and now regarded by Wachsmuth and Springer as a Crinoid of low organization. The anomalous recurrent ambulacra of this type seem also to occur in two other Trenton Crinoids, *Taxocrinus degans*, Billings, sp., and *T. lavis*. We regard this observation as a most important and suggestive one, and shall await further information respecting these very early and somewhat generalized forms with no little interest.

Except perhaps for the biserial arms of some species, we do not quite understand the reasons which have induced Messrs. Wachsmuth and Springer to transfer the Encrinidæ to the Palæocrinoidea. Their diagnosis of the family (p. 194) commences as follows:—"Dicyelic. Closely allied to the Poteriocrinidæ, but, *as a rule*, without anal plates." The insertion of the words "*as a rule*"† is somewhat misleading; for it implies that there are some members of the family in which anal plates do occur. But there is no mention of their presence in the authors' diagnosis either of *Encrinus* or of *Dadoocrinus*, the only two genera comprised in the family, and, in fact, *they have never been described*; while Wachsmuth and Springer seem to be in no doubt at all about the presence of interradials in *Encrinus*, though they admit that these, "owing to the large size of the articular facets, must have been small at any time, and possibly were absorbed in the adult" (p. 259). It appears to us, however, that the mature *Encrinus* never can have had calyx-interradials of any kind, since there was no room for them. Not only the second and third radials, but also the primary and secondary arm-divisions (when present) were in close lateral contact all round the cup, with their apposed sides flattened against one another, just as in many tropical *Comatulæ*. Even if interradials had been present in earlier life, as in some *Comatulæ*, and subsequently resorbed, as Wachsmuth and Springer believe, they must have been situated above and not between the primary radials, which form a perfectly symmetrical pentagon without any trace of interradials resting upon them. Messrs. Wachsmuth and Springer place under *Erisocrinus* those *Encrinus*-like Palæozoic species "in which a plate of the ventral tube rests upon the radials. In all probability was the latter piece always present in this genus" (p. 255). *Erisocrinus* is one of the two Palæozoic Poteriocrinidæ which come nearest to *Encrinus*; but the American authors regard

* *Antea*, p. 403. See also Ann. & Mag. Nat. Hist. March 1886, pp. 282-284.

† The *italics* are due to the authors, and not to the reviewer.

it as probable that the posterior radials supported a ventral tube, and this would introduce an asymmetry into the calyx, of which there is no trace whatever in *Enerinus*. This much they admit on p. 230, where they say:—"In the same degree as palæontologically the calyx grows more symmetrical, the ventral sac decreases in size, and probably disappeared entirely in *Enerinus*, which is closely allied to the Poteriocrinidæ." In like manner they describe their specimens of *Stemmatocrinus Trautscholdi* as showing "traces of inter-radial plates resting against the inner edges of two radials, of which the places of attachment are plainly visible, and detached plates were placed aside of them." (p. 256). These plates, however, are altogether absent in the Enerinidæ, every species of which has the third radial axillary, a character which is very constant among Neocrinoids, and is by no means so in the Poteriocrinidæ, the second being axillary in *Erisocrinus* and *Stemmatocrinus*. Considering these and other points which we are unable at present to discuss, we cannot but feel that Wachsmuth and Springer have not made out their case for the transfer of the Enerinidæ to the Palæocrinoidea. They express themselves as "willing to admit that *Enerinus* constitutes a transition form towards the Neocrinoidea, it is even possible that in the adult the interradials become partly or wholly resorbed, but it is otherwise so closely connected with the Poteriocrinidæ that we must regard it as a Palæocrinoid, or place also the Poteriocrinidæ among the Neocrinoidea" (p. 257). When they shall have discovered that the calyx of *Enerinus* has an azygos side indicating the presence of the ventral tube, which is so characteristic of the Poteriocrinidæ, we shall be more disposed to agree with them. They say on p. 230, "Comparing *Erisocrinus* with *Enerinus*, the only noticeable difference in their fossil state is the presence of a single brachial in the former and two in the latter." But in making this statement they entirely ignore the fact to which they allude on p. 255, viz. that in *Erisocrinus* a plate of the ventral tube rests upon the radials, while nothing of the kind occurs in *Enerinus*; and yet it is almost exclusively upon this point that the whole question turns. Their comparison of *Enerinus* and *Erisocrinus* is also incomplete in another respect. Not only has *Enerinus* three radials and *Erisocrinus* two, but the authors admit, on p. 192, that the two outer radials and the proximal arm-plates of *Enerinus* are respectively united by syzygy. They ought to know, though they seem to be unaware of it, that this is in accordance with a rule "which holds good in almost all the Neocrinoids"*. But they also expressly state on p. 192 that syzygies are not known to occur in the Poteriocrinidæ, and so furnish another argument against their transfer of *Enerinus* to the Palæocrinoids.

The Catilloocrinidæ and Calcoocrinidæ are two extremely puzzling families, the morphological study of which is beset with the very greatest difficulties. We think, however, that Messrs. Wachsmuth and Springer have successfully overcome many of these difficulties, and that their analyses of the structure of these curious types will be even-

* Report on the 'Challenger' Crinoidea, p. 49.

tually accepted as correct. They have also been remarkably successful in elucidating the structure, and so fixing the systematic position, of that very singular form *Stephanocrinus*, which has been variously referred to the Crinoids, Cystids, and Blastoids. The American authors show, however, by the aid of some unusually perfect material, that it is really a Brachiata Crinoid "with branching biserial arms, given off in a somewhat similar manner as the arms in the Platycrinidæ." We are very glad to find them now admitting that the ventral pyramid above the mouth is composed of orals, and not of calyx-interradials*, and that *Stephanocrinus* is allied to *Allagerinus* and *Haplocrinus*. But we cannot at all follow the argument by which they endeavour to prove that this oral pyramid is homologous with the central plate which they have discovered in the dome of some specimens of *Haplocrinus mespiliformis*. A full discussion of this question, however, would be impracticable at present; and the same may be said with respect to the concluding "Notes on the Underbasals and Top Stem-joint of Neocrinoida and Palæocrinoida." The authors claim that the symmetry of the top stem-joint in the Apiocrinidæ is interrarial, and that the family is consequently built upon the plan of dicyclic Crinoids. There is one slight difficulty in the way of this theory. The top stem-joint certainly has interrarial angles in somewhat less than half the species of *Millericrinus*; but in *Guetardicrinus*, *Apiocrinus*, and in the majority of the species of *Millericrinus* the angles of this top stem-joint are distinctly radial, and the explanation given of this awkward fact by Messrs. Wachsmuth and Springer is that the plate "attained its radial angles accidentally by adapting its form to the basal concavity, which is naturally angular" (p. 297).

We are certainly somewhat surprised to be told that the structure of the upper stem-joint, which presents itself in two out of the three genera and in the majority of the species of the Apiocrinidæ, and is especially characteristic of this family as distinguishing it from the Pentacrinidæ, is an "accidental" one †. But the authors are thereby enabled to make the generalization on p. 299, "that the top stem-joint is disposed interradially in the Apiocrinidæ, Pentacrinidæ, and Comatulæ, similar to dicyclic Palæocrinoids." The top of the centro-dorsal certainly has interrarial angles in the adult *Comatula*; but its angles are radial before the cirri appear, as is permanently the case in *Apiocrinus*, and the symmetry changes when the radials grow faster than the basals and come to rest directly on the centro-dorsal. But we cannot understand in the least how this proves that the *Comatulæ* "are built upon the plan of dicyclic Palæocrinoids;" and considering that in *Pentacrinus* and also in some species of *Millericrinus* the symmetry of the axial canal is interrarial, a character which we cannot regard as having been attained "accidentally," we are inclined to believe that of the

* See Ann. & Mag. Nat. Hist. March 1886, p. 282.

† If the basal concavity "naturally" has radial angles, is it not a "natural" and not an "accidental" circumstance that the top stem-joint which occupies this cavity should also have radial angles?

two alternatives suggested by Wachsmuth and Springer on p. 298 the first is preferable, viz. that "the rules which meet with no exception among the Palæocrinoidea, as far as we know, do not hold good for the Neocrinoidea." The American authors, however, elect for their other alternative, and believe that Neocrinoids are really "built upon the plan of dicyelic Crinoids." They are therefore driven to suggest "accidental" causes to explain away facts which do not suit their theory.

At the end of the volume are nearly four pages of additions and corrections which apply to all the three parts of the 'Revision;' and we strongly advise palæontologists who wish to use the work to commence by making the necessary alterations in their copies. If this be neglected they will rise from the perusal of some passages with an impression altogether different from that which the authors meant to convey. This is especially the case in those parts of the book which contain discussions of disputed questions, *e. g.* the systematic position of *Encrinus*, on p. 231, and the composition of the calyx of *Stemmatoocrinus*, on p. 255. We cannot but think that the authors would have been spared the necessity of correcting their statements in these and similar instances if they had taken a little more trouble to give exact references to the writings of fellow-workers whom they quote.

This is no doubt an excessively laborious task; but prevention is notoriously better than cure, and there is no more certain means of avoiding misquotation than a free use of exact references. Messrs. Wachsmuth and Springer have, however, largely dispensed with such references, and we could mention several instances in which the accuracy of their statements has suffered in consequence. But this is a matter of more importance to themselves than to any one else; while they have done a most valuable service to their fellow-workers by the preparation of a copious index to all three parts of their 'Revision.' It does not appear in the 'Proceedings of the Philadelphia Academy,' where their work was originally published, but has been inserted at their own expense into the numerous separate copies of the concluding section of the 'Revision' which they have obtained for distribution. The preparation of this index, which occupies thirty-one pages of double columns, must have been a work of immense labour, for which they will receive the heartiest thanks of all students of the Pelmatozoa. The discoverer of a new specific or generic type will now be able to see what names are preoccupied, and he will no longer have any reason for enriching zoological science with new synonyms. That an index of this kind was wanted may be judged from the fact that a new genus *Triacrinus*, with a type species *T. pyriformis*, were described in 1884 by an American palæontologist, who was unaware that not only the generic, but also the specific, name had been preoccupied by Münster in exactly the same connexion as long ago as 1839!

Messrs. Wachsmuth and Springer assure us that their index "contains a complete list of all generic and specific names used in connexion with the Palæocrinoidea" (p. 303). We have certainly

found that it does contain a very large number of the less known names; but we are not a little surprised at the omission of the three species described in 1884 by Ringueberg in the 'Proceedings of the Academy of Natural Sciences of Philadelphia,' the same journal in which the successive parts of the 'Revision' appeared, viz. *Triacrinus pyriformis*, *T. globosus*, and *Eucalyptocrinus inconspicuous*. Ringueberg described his new genus *Triacrinus* as allied to *Hybocrinus*; but neither in the section on the Hybocerinidæ nor anywhere else in the third part of the 'Revision' can we find any mention of Ringueberg's genus.

We also miss any reference in the index to *Apiocrinus dipentis*, and likewise to *Isocrinus nobilis* and *Chladocrinus nobilis*, synonyms of the type which Waehsmuth and Springer call *Taxocrinus nobilis*; while the references which are given to two other synonyms of this species (*Poteriocrinus nobilis* and *Forbesiocrinus nobilis*) are both incorrect. It would have been better too if the names *Barrandeocrinus*, *Cavis-trocrinus*, and *Centrocrinus* had been placed respectively before *Barycrinus*, *Carabocrinus*, and *Ceriocrinus*, instead of after these names.

In spite of these and other errors of detail, however, many of which are no doubt due to the circumstances under which the work was prepared, as hinted on p. 299 of Part III., we have no hesitation in saying that the 'Revision of the Palæocrinoidea' is a memoir of the utmost value and importance. It will be indispensable alike to the morphologist who wishes to study the remarkable Crinoid types which flourished in the Palæozoic seas, and to the pure systematist who desires a natural classification of one of the great groups of Echinoderms—that large subkingdom in the study of which one may find some relief from the everlasting strife about the mutual relations of Worms and Arthropods, Ascidians and Vertebrates, and all the latest productions of the most advanced speculative zoology; while the stratigraphical palæontologist, who wishes to determine the age of a bed by the characters of its fossils, will find in the 'Revision' much food for reflection in the most valuable information respecting transition-forms in Crinoids and their palæontological development through a long series of strata.

P. HERBERT CARPENTER.

Catalogue of the Blastoidea in the Geological Department of the British Museum (Natural History), with an Account of the Morphology and Systematic Position of the Group, and a Revision of the Genera and Species. By ROBERT ETHERIDGE, Jun., and P. HERBERT CARPENTER, D.Sc., F.R.S., F.L.S. 4to. Pp. i-xvi, 1-322; 20 plates. London: Printed by Order of the Trustees, 1886.

A YEAR and a half ago we noticed in this Journal * a very important

* Ann. & Mag. Nat. Hist. ser. 5, vol. xv. p. 346.